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PLANT HABIT IN RICE:
ITS EFFECT ON PRODUCTIVENESS AND ADAPTATION

by Sterling Wortman[1]

In recent decades, there have been marked changes in the plant habit of many food crops, particularly in the small grains--wheat, oats, barley, rice--in sorghum and in some other crops. Varieties important today generally are shorter, less leafy, and have much stiffer straw than their predecessors. One major need for the shift is obvious: as fertilizer usage increased, plants of older varieties tended to be taller and to lodge, or fall over before harvest, reducing yield. Another reason, perhaps quite important, has been less evident: plants which are relatively early in maturity and have no more foliage than is necessary to produce a panicle or ear of reasonable size, may be much more efficient in producing carbohydrate reserves, or grain, and inherently higher yielding. Recent work on rice by Tanaka (1,2), who in turn has drawn heavily upon the findings of other Japanese workers, has shown clearly that high production of grain per unit area per unit time requires varieties with a relatively few erect leaves, stiff straw to prevent lodging, and a shortened growth period. Jennings and Beachell, also at the International Rice Research Institute, are now attempting to produce such varieties for Southeast Asia.

Most rice varieties now available to the farmers of tropical Asia are tall, are quite leafy, and tiller profusely. With minimum care in the field, and with low levels of soil fertility, they produce relatively low, but fairly certain, grain yields. Such varieties will tolerate a wide range of water depths and, because of their relatively fast growth, they compete reasonable well with weeds. These types, then, are well suited for the conditions under which they have been grown. However, when such varieties are fertilized, particularly during the rainy season when light intensity is low, grain yields may be drastically reduced. It now has been shown rather clearly that, during the wet season, increased levels of nitrogen fertilizer result in substantially increased vegetative growth, which in turn restricts light penetration into the canopy. A serious imbalance may develop between photosynthesis and respiration.

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SHOUT
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IT

In rice, respiration--which utilizes carbohydrates--continues day and night, and is roughly proportional to total leaf area. Photosynthesis of a plant also is proportional to leaf area, but only if all leaves are similarly illuminated. If, as the plants in a rice field develop, vegetative growth of a plant is excessive for the space allotted, particularly during the latter stages of the crop growth period, shading of lower leaves reduces photosynthetic rates of those leaves and total carbon assimilation by the plant, while respiration is little affected, if at all. Crowding of plants in a field, or excessive nitrogen fertilization, have been shown to aggravate the competition for light.

During the wet season, when light intensity is low, the short plants--perhaps having a grain: straw ratio of 1:1 or more at harvest--have been most efficient in grain production. Because of the limited light supply and relatively high rates of respiration, it is necessary that leaves receive adequate exposure to light. This becomes difficult with large plants and high nitrogen levels.

During the dry season at the International Rice Research Institute, night temperatures are somewhat reduced, slowing respiration, while light intensity and photosynthetic rates are high. Effectiveness of light penetration into the plant canopy increases, and more plants per unit area can be used successfully than in the wet season. Also, because photosynthesis is rapid but shading does not become a serious limiting factor, high rates of nitrogen fertilization have resulted in higher grain yields--the opposite of findings in the wet season.

Therefore, under conditions of good management and high fertility, the use of relatively early varieties with a high grain:straw ratio appears necessary for efficient grain production, regardless of season.

In the tropics, where the crop season is not regulated by temperature (frost), availability of water often becomes a controlling factor in determining optimum length of growth period of a crop. With irrigation, this factor can be minimized in rice culture, and maximum grain production per unit time (rather than per crop on the U. S. mainland) becomes a major objective. A knowledge of the role of plant habit in providing for maximum utilization of light energy becomes most useful. One wonders if the information developed for rice may not apply to other tropical crop plants, at least in part.

Further information on this and related topics will be found in the Proceedings, International Symposium on the Mineral Nutrition of the Rice Plant, which soon should be available from The International Rice Research Institute (Manila Hotel, Manila) or from the Johns Hopkins Press.

Literature Cited

1. Annual Report. The International Rice Research Institute, 1961-62
2. Annual Report. The International Rice Research Institute, 1963

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LIFE BEGINS AT FORTY

Unlike people, societies can pass a 40th birthday without particular misgivings. Nonetheless, Hawaiian botanists do well to pause for a moment's reflection as their society forges into its 5th decade.

The Hawaiian Botanical Society grew out of informal meetings in 1924 of Dr. H. L. Lyon, Dr. F. C. Newcombe, and Mr. H. A. Lee. On the 5th of May, 1924, the Society held its first meeting. Among its 21 charter members, at least one, Joe A. Martin, is still an active member of the Society. The early history of the Society has been chronicled briefly by Dr. Constance Hartt in Paradise of the Pacific, Vol. 49 (1937), and again in 1947 by officers of the Society. A few copies of the latter publication entitled "The Hawaiian Botanic Society 1924-1949," are available in our files (Sinclair Library, University of Hawaii).

Throughout the 40 years that have transpired, the monthly meetings of the Hawaiian Botanical Society have featured visiting and local botanists, many of wide renown, and the Society has often initiated endorsed or criticized activities affecting the botany and beauty of our State. In recent years, the Society has lent active support to establishment of a National Tropical Botanic Garden, started a series of Botanical forays, sponsored plant science awards for deserving students, and established a Newsletter. Our membership has continued to grow, doubling since the end of World War II to its present 200-plus.

Now--in 1965--we can look back on an exciting decade for Hawaii--our statehood, the birth of our Pacific Tropical Botanic Garden and the emergence of our State as a vital center between East and West (and between tropics and temperate lands).

What lies ahead? Clearly, we are entering an era of unprecedented interest and importance of tropical plants--plants that promise new biochemical products, new foods and feeds, new beauty for our world of burgeoning asphalt jungles. If Hawaii's botanists fail to figure prominently in this new era, we will have no one but ourselves to blame.

----- James L. Brewbaker

NOTES AND NEWS

HAWAIIAN SCIENCE FAIR WISH AWARDS: The Hawaiian Botanical Society is happy to announce that the winners of the Wish Awards for the 1965 Science Fair are:

$15 Senior Division Award: Edwin Chinn of Kalani High School, Honolulu for his project titled "The Effects of Auxin from various Sources on the Growth of the Sweet Pea."

$10 Intermediate Division Award: Adele Azama and Shirley Fujimoto of Highlands Intermediate School, Pearl City for their project titled "The Effect of varying Concentrations of 2,4 Dichlorophenoxyacetic acid on the Rate of Germination of two Parsley Varieties."

PLANT RAFFLE REMINDER!!

Now is the time to get rid of those plants which are too valuable to throw out but for which you have no room. All plant donations cheerfully accepted for this raffle to replenish our refreshment fund.

APRIL MEETING

On Monday, April 5 at 7:30 p.m. in Agee Hall at the HSPA Experiment Station, Dr. Harold St. John will speak on "Pandanus from seashore to mountain top." Dr. St. John, presently Botanist at the Bishop Museum and Professor Emeritus at the University of Hawaii, recently returned from a six-year world-wide research engagement with Pandanus. During this period he taught one year at Chatham College in Pittsburg, two years at the University of Saigon, one year at the University of Cairo, and spent two years in Europe. Dr. St. John was formerly Professor and Chairman of the Botany Department and Wilder Professor of Botany at the University of Hawaii.

FLORA PACIFICA

The annual Flora Pacifica display, sponsored by the Friends of Foster Garden and the Friends of the East-West Center, will be in Jefferson Hall of the East-West Center at the University of Hawaii from April 21-25. This annual display features plants which are indigenous to the Pacific Basin. All interested botanists are urged to attend.

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THE HAWAIIAN BOTANICAL SOCIETY was founded in 1924 to "advance the science of Botany in all its applications, encourage research in Botany in all its phases," and "promote the welfare of its members and to develop the spirit of good fellowship and cooperation among them." "Any person interested in the plant life of the Hawaiian Islands is eligible for membership in this Society."

The Hawaiian Botanical Society Newsletter is published in February, April, June, October, and December. It is distributed to all Society Members and other interested institutions and individuals with the purpose of informing them about botanical news and progress in Hawaii and the Pacific. News contributions and articles are welcomed. The deadline submission of news items is the 20th of each month prior to publication. Produced at the University of Hawaii and at the Experiment Station, HSPA. Membership dues are $3.00 per calendar year and include receipt of the Newsletter.

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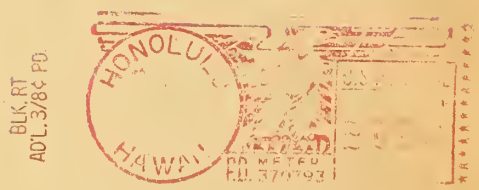

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